Space Weather Technical Forecast

Issued on Friday, 27 October 2023 at 01:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Coronal hole influence bringing a chance G1/Minor Storm intervals initially, and likely G1-G2/Minor to Moderate Storms into day 4 (30 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with occasional C-Class flare activity and a peak M1.4 flare at 26/2324 UTC from the region of newly numbered AR3473. There are four sunspot regions on the disc. Two numbered in the southwest disc, which are both small, although AR3471 has shown development of weak intermediate spots. A further small unnumbered spot between them has now fading. The newly numbered AR3472 in the northwest is a small bipolar region, however further development is possible. A further small region closer to the limb is now numbered AR3473, with ongoing development also possible.

No Earth-directed CMEs have been observed in available imagery. The recent M-flare looks to have been associated with a CME, though based on the position an Earth directed competent looks unlikely. We await imagery for a full assessment.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, showed a likely connection to the fast wind of CH64/+. Solar wind speeds steadily increased from background, around 330km/s, to become elevated around 500 km/s. Density was mostly average, becoming increasingly below average. The interplanetary Magnetic Field (IMF), Bt, was initially weak, below 5nT, but increased in a step-wise fashion through the first half of the period, peaking at 13nT around 0830 UTC, and becoming persistently Moderate around 10nT. The north-south component, Bz, was highly variable, with a similar increasing trend in magnitude, ranging between +9 and -12nT. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet to Active (Kp 1-4).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was at background levels. Associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 27/0000UTC was 1.29e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity forecast with occasional C-Class flares. There is a slight chance of isolated M-flares, perhaps increasing slightly through the period depending upon any further sunspot development.

Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs expected. Current solar wind enhancement likely due to a connection to CH64 is expected to see a reduction in speeds during the next 24hrs, though a enhanced risk of geomagnetic activity persists to start the forecast period. A return to more benign conditions then expected into day 2 (28 Oct). The next enhancement is then expected to be from the large coronal holes CH65 and CH66 both approaching centre disk, either later on day 3 (29 Oct) or early day 4 (30 Oct). Unsettled to

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Active geomagnetic activity is expected into day 1 (27 Oct) with a chance of G1 Minor Storms intervals. Conditions expected to ease to mainly Quiet with a chance of Unsettled spells into day 2 (27 Oct). G1/Minor storms are increasingly likely through day 3 into day 4 (29-30 Oct) with the expected onset of CH65/66 fast winds.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at Background. High energy electron flux (greater than 2MeV) is expected see a small increase from background to moderate at first, with a chance of reaching High at diurnal peak by day 2 (28 Oct). The associated 24 hour fluence is forecast to remain below the Active threshold (1e8 integrated pfu).

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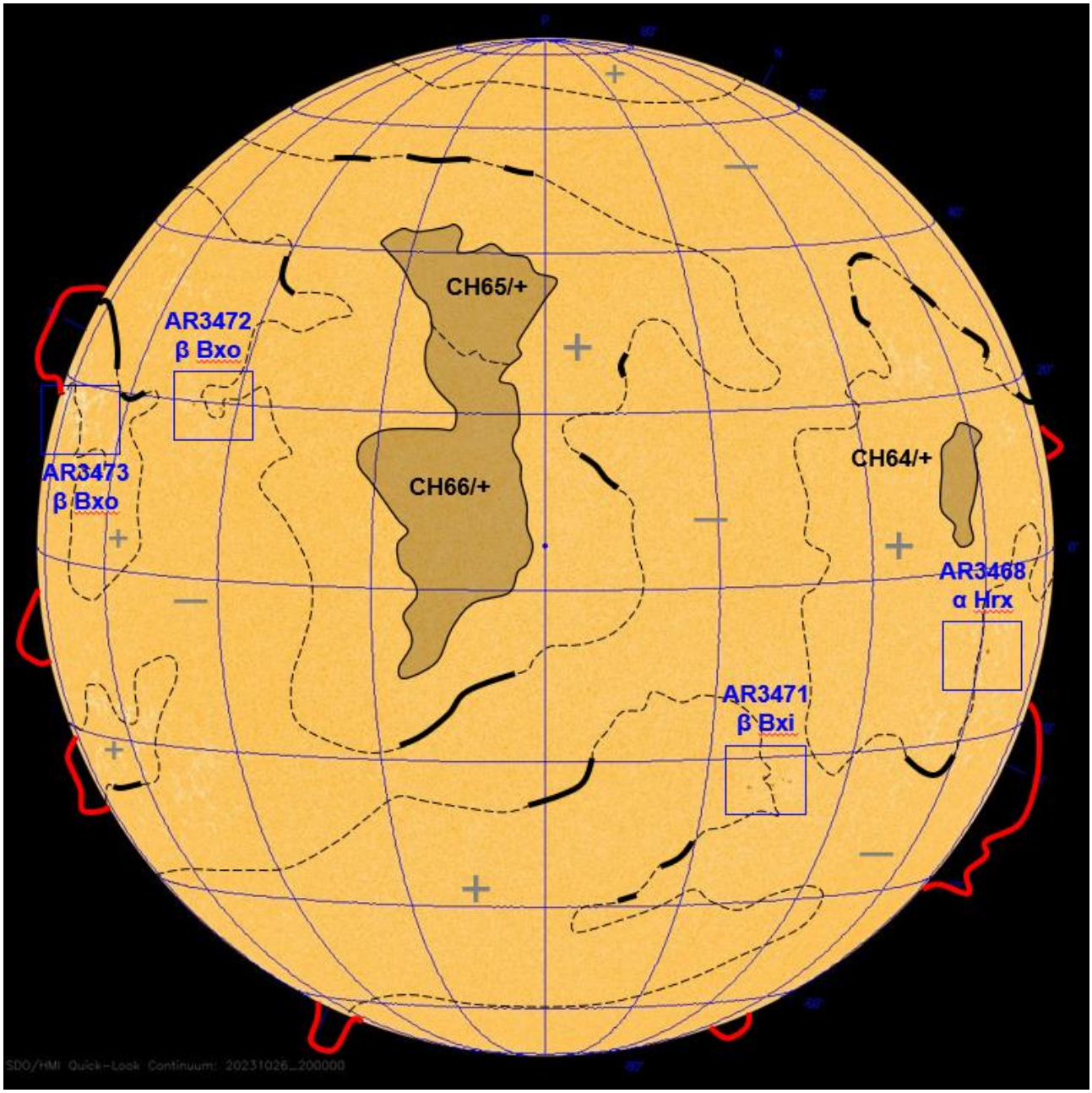
Figure 1. Solar Analysis Valid 26/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are currently no Earth-directed CMEs forecast.

Current solar wind enhancement is likely due to a connection CH64. This feature has been stronger than expected but looks to be peaking with a reduction in speeds expected during the next 24hrs, though a enhanced risk of geomagnetic activity persists to start the forecast period. A return to more benign conditions then expected into day 2 (28 Oct). The next enhancement is then expected to be from the large coronal holes CH65 and CH66 both approaching centre disk. Influence from these non recurrent features expected either later on day 3 (29 Oct) or early day 4 (30 Oct).

MOSWOC Enlil output suggests a strong fast wind onset on day 2 (28 Oct), however this is though likely not representative of the fast winds of CH65/+ and CH66/+, which are new features on this rotation.

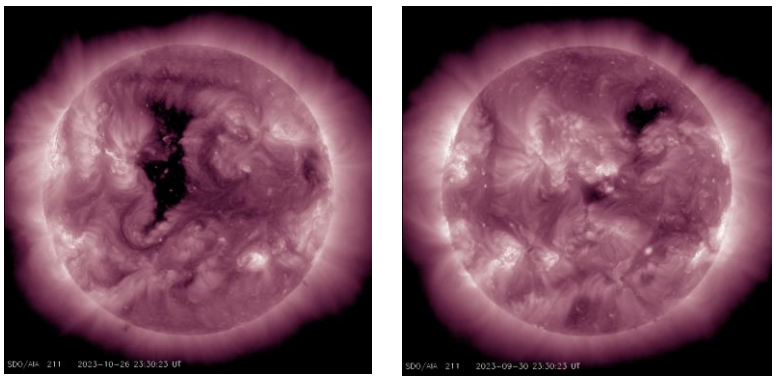
Unsettled to Active geomagnetic activity is expected into day 1 (27 Oct) with a chance of G1 Minor Storms intervals. Conditions expected to ease to mainly Quiet with a chance of Unsettled spells into day 2 (27 Oct). G1/Minor storms are increasingly likely through day 3 into day 4 (29-30 Oct) with the expected onset of CH65/66 fast winds.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	10	30	60
Strong	G3	No	1	1	5	10
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

Figure 2: SDO aia-211 imagery this rotation (left) and previous (right), markedly different CH structure



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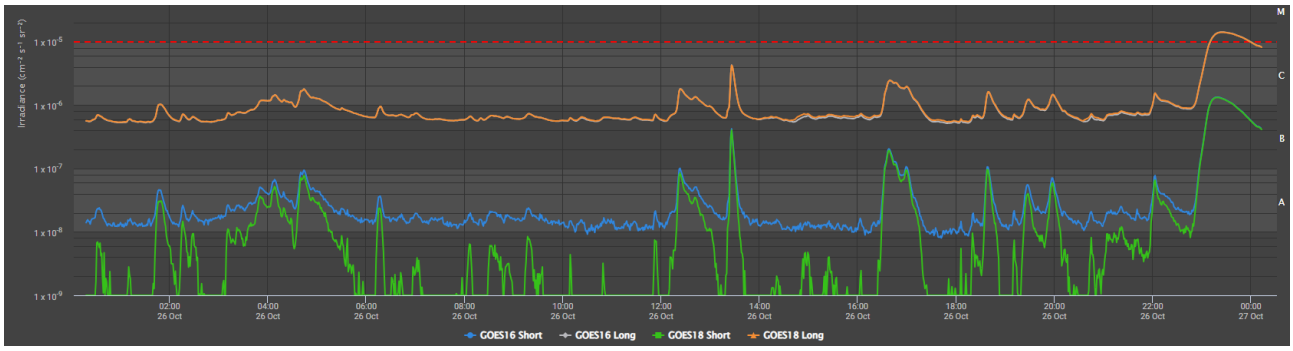
Radio Blackouts - X-Ray Flares:
Low activity is expected with only a slight chance of M-flares, though this likely slowly increasing. There are four sunspot regions on the disc. Two numbered in the southwest disc, which are both small and declining with minimal activity. Two small regions in the northeast bring the potential for further sunspot development through the coming days. Limited signal from far side data to suggest any significant new regions are expected to rotate onto the disk during the period, however a general increase in activity should be expected given the current position in the solar cycle, hence the slow increasing in flare risk.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	10	10	15	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Latest 24hr GOES16/18 X-ray trace showing recent M-flare



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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels in the absence of significant sunspot regions on the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):
Electron flux observed by GOES16 at GEO is currently at Background levels with only slight diurnal rises to Moderate expected. Some increase to electron populations through the Van Allen Belt is possible through the period due to the coronal hole enhancement forecast ongoing into day 1 (27 Oct) from CH64, bringing a slight chance of reaching High at diurnal peak by day 2 (28 Oct). The following fast wind from CH65/+ and CH66/+ is anticipated to have a more significant impact on electron populations, however this is not expected until beyond the current forecast period (31 Oct onward).

The associated 24hr electron fluence is forecast to remain below the Active level. This is supported by REFM, though persistence provides a poor guide due to influence of CMEs on the previous rotation.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	1	10	10	1
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

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